

# Existing Knowledge of PCB Delivery Pathways

# Objective

- Summarize all known information on the magnitudes of various PCB loading pathways
  - upstream Lake Coeur d'Alene, WWTPs, stormwater, groundwater, tributaries
- Reconcile Task Force estimate of loads with that of prior Ecology assessment Serdar et al (2011)
- Assess how much is known about “unknown” loads

# Reconciling Serdar with Recent Studies

- Results of Ecology 2011 loading assessment appear much different than recent Task Force studies
  - e.g. 57% of the load is unknown
- Why?

# Reconciling Serdar with Recent Studies

## Loading Pyramid

- Serdar loading assessment was summarized in terms of a pyramid

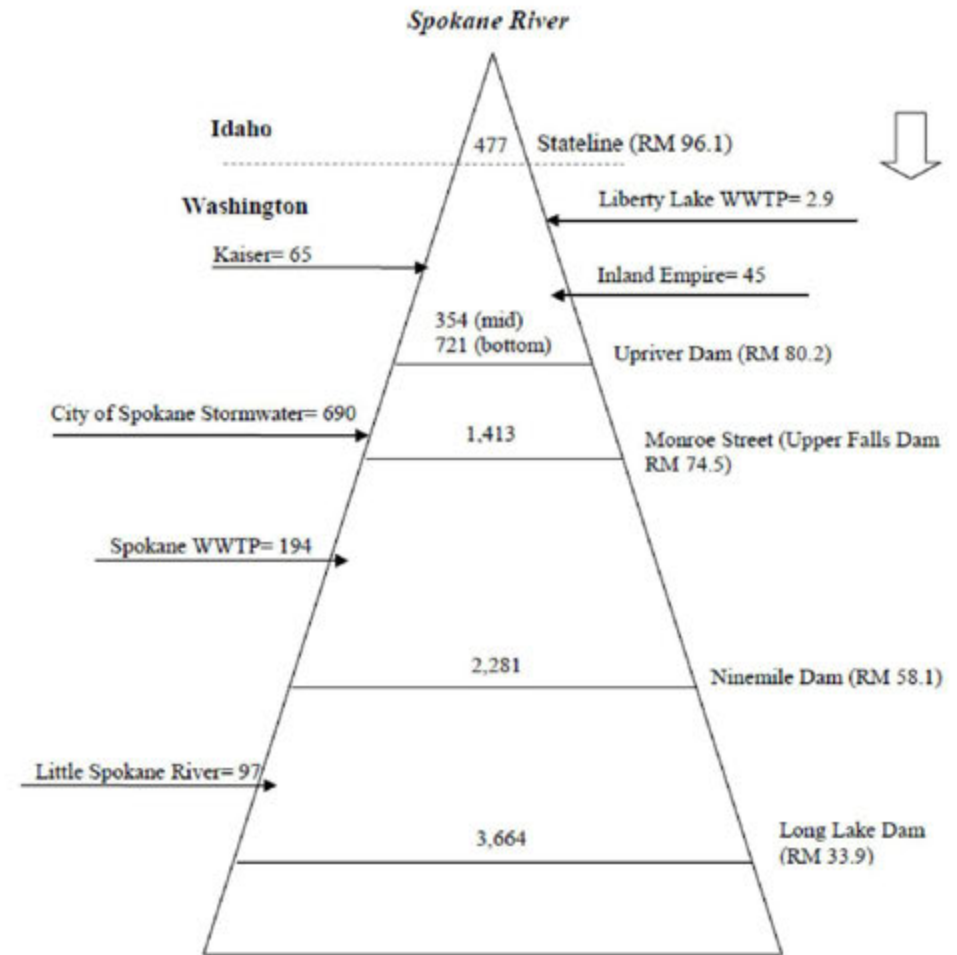


Figure 19. Schematic of PCB Sources and Instream Loads in the Spokane River (total PCB, mg/day).

# Reconciling Serdar with Recent Studies

## The Pie Chart

- Serdar loading pyramid has been condensed into a pie chart

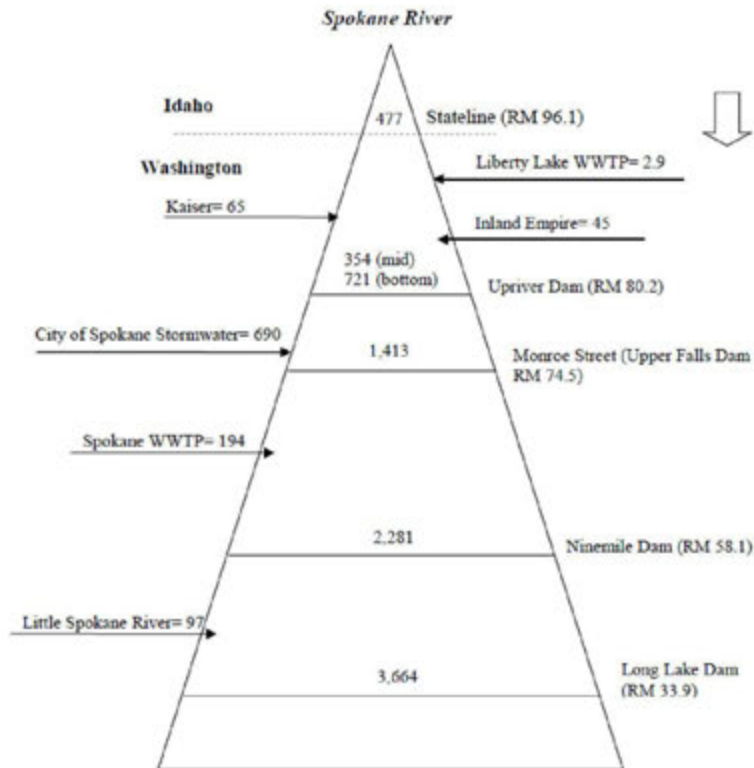
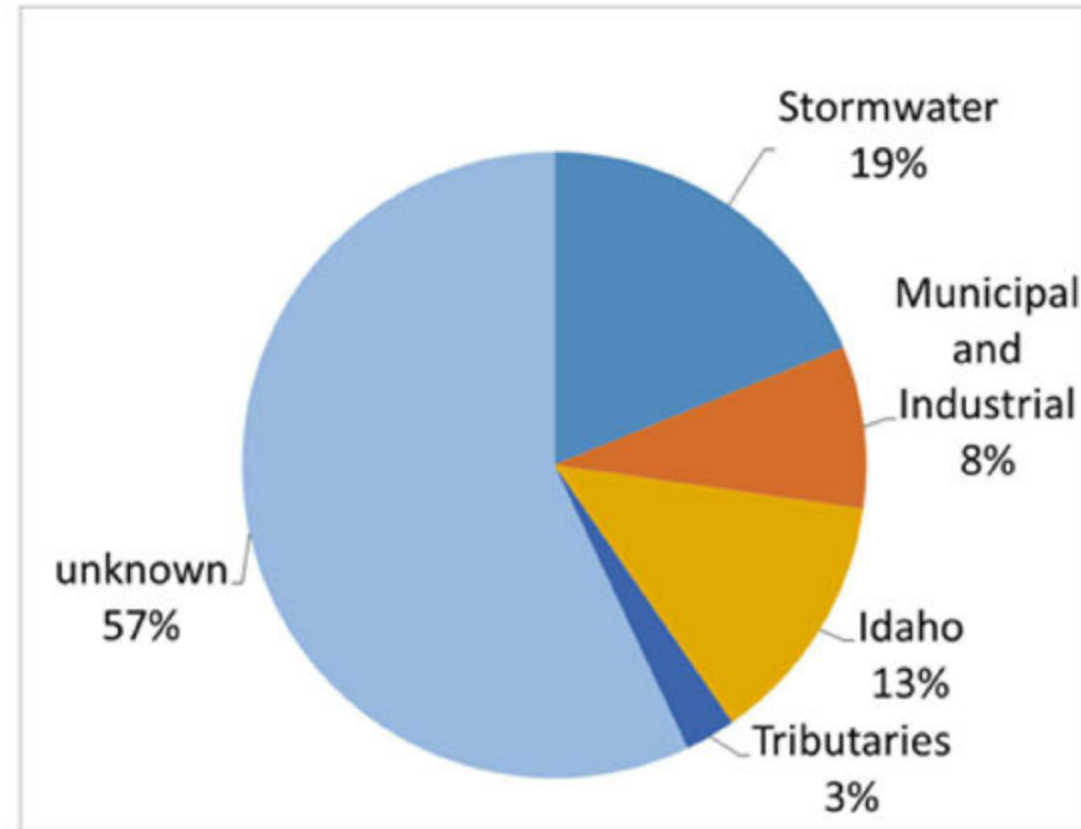


Figure 19. Schematic of PCB Sources and Instream Loads in the Spokane River (total PCB, mg/day).

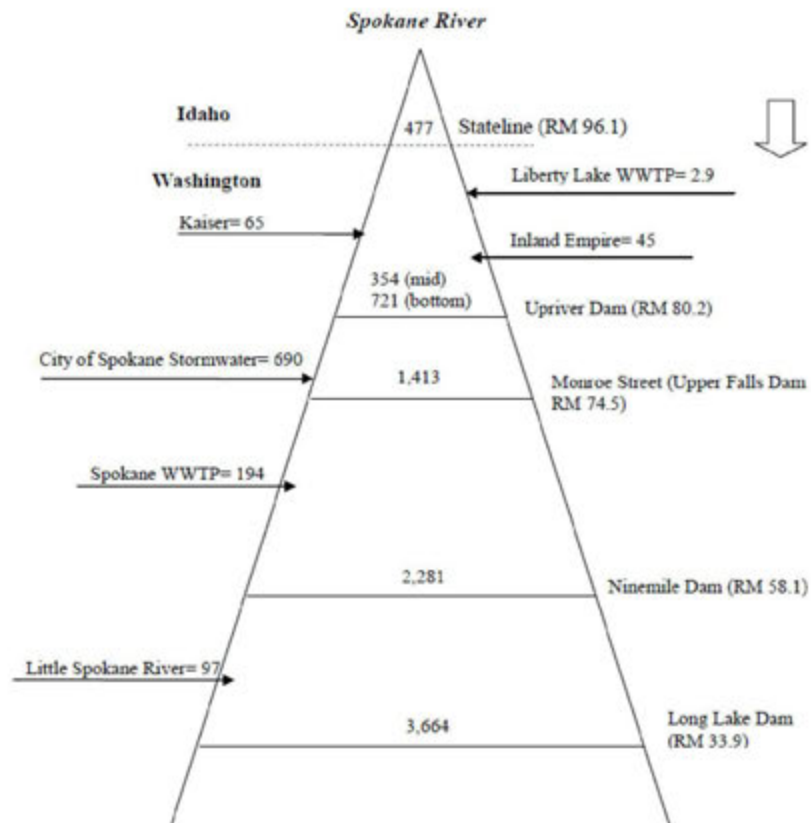




# Reconciling Serdar with Recent Studies

## Deconstructing the Pie Chart

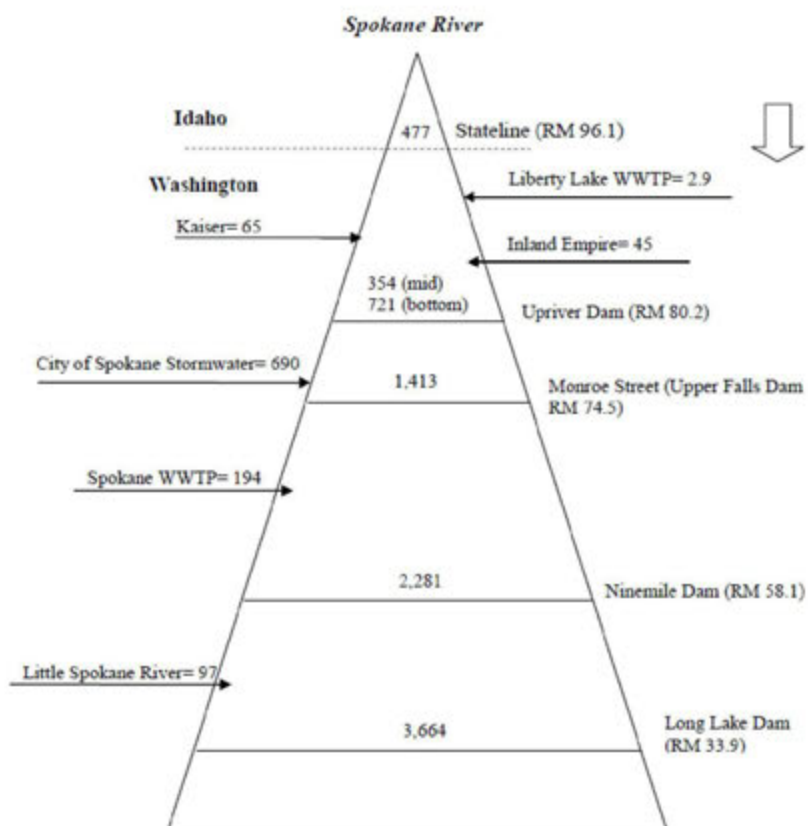
- Back-calculate unknown load by reach



Reach	In-River Load (mg/day)	External Load (mg/day)	Unknown Load (mg/day)
Stateline	477		
		2.9+65+45=112.9	
Upriver	537.5		$537.5 - 477 - 112.9 = -52.4$
		690	
Monroe	1413		$1413 - 690 - 537.5 = 185.5$
		194	
Nine Mile	2281		$2281 - 1413 - 194 = 674$
		97	
Long Lake Dam	3664		$3664 - 2281 - 97 = 1286$
<b>Total</b>			<b>2093.1</b>

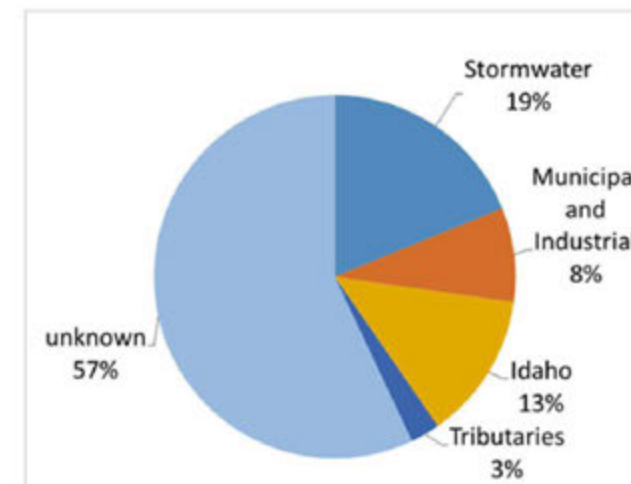
# Deconstructing the Pyramid

- Numbers in pyramid directly translate to numbers in pie chart



Reach	In-River Load (mg/day)	External Load (mg/day)	Unknown Load (mg/day)
Stateline	477		
		2.9+65+45=112.9	
Upriver	537.5		537.5-477-112.9=-52.4
		690	
Monroe	1413		1413-690-537.5=185.5
		194	
Nine Mile	2281		2281-141-194=674
		97	
Long Lake Dam	3664		3664-2281-97=1286
Total			2093.1

Category	Load (mg/day)	% of Total
Stormwater	690	19%
Municipal and Industrial	306.9	8%
Idaho	477	13%
Tributaries	97	3%
Unknown	2093.1	57%
<b>Total</b>	<b>3664</b>	



# Reconciling Serdar with Recent Studies

## Summary Comparison

- Why are there differences from the Task Force findings?
  - Spatial domains don't match
    - Majority of Serdar unknown load occurs outside of area considered by Task Force studies
  - Seasonal periods don't match
  - Sampling methodology doesn't match



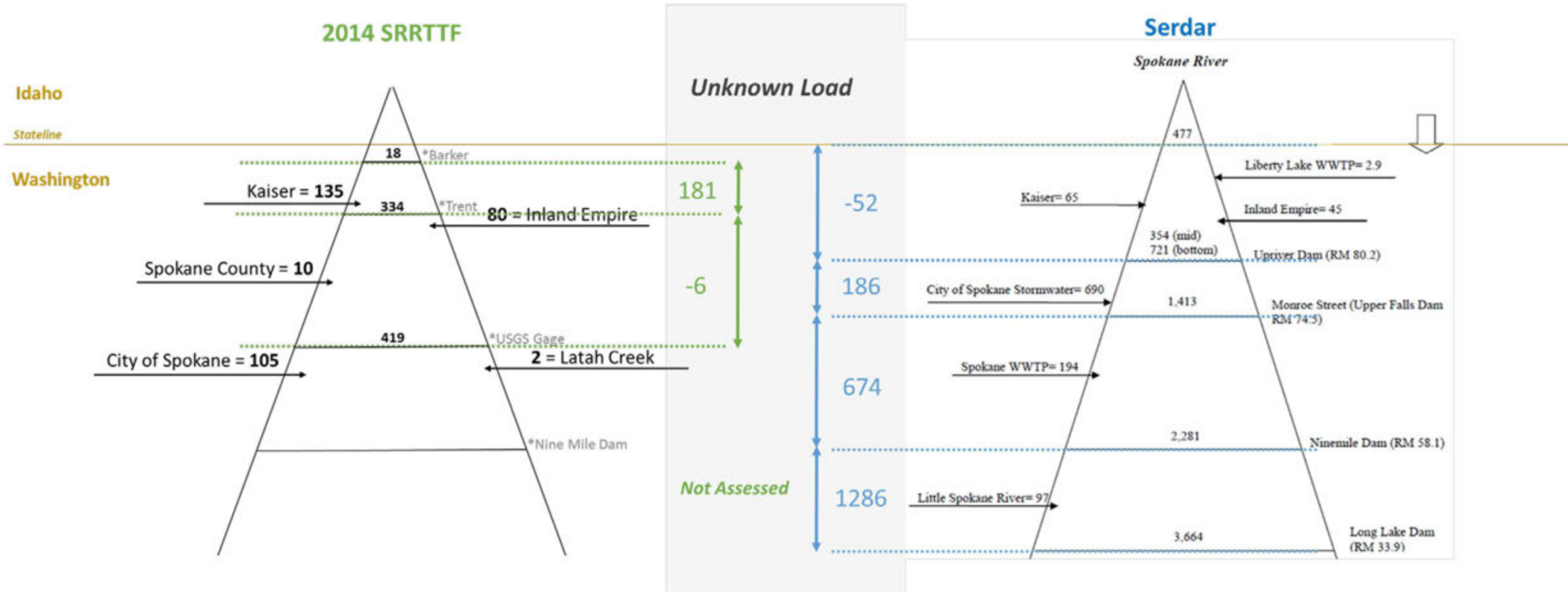
# Reconciling Serdar with Recent Studies

## Spatial Domains Don't Match

- Serdar
  - State line to Long Lake Dam
  - Instream load estimates at:
    - Upriver Dam, Monroe St. and Nine Mile
- Task Force
  - 2014: Lake Coeur d'Alene to Nine Mile
  - 2015: Barker Rd. to Spokane USGS Gage
  - 2018: Barker Rd. to Nine Mile
  - Instream load measurements at:
    - Barker Rd. Mirabeau, Plante's Ferry, Greene St.

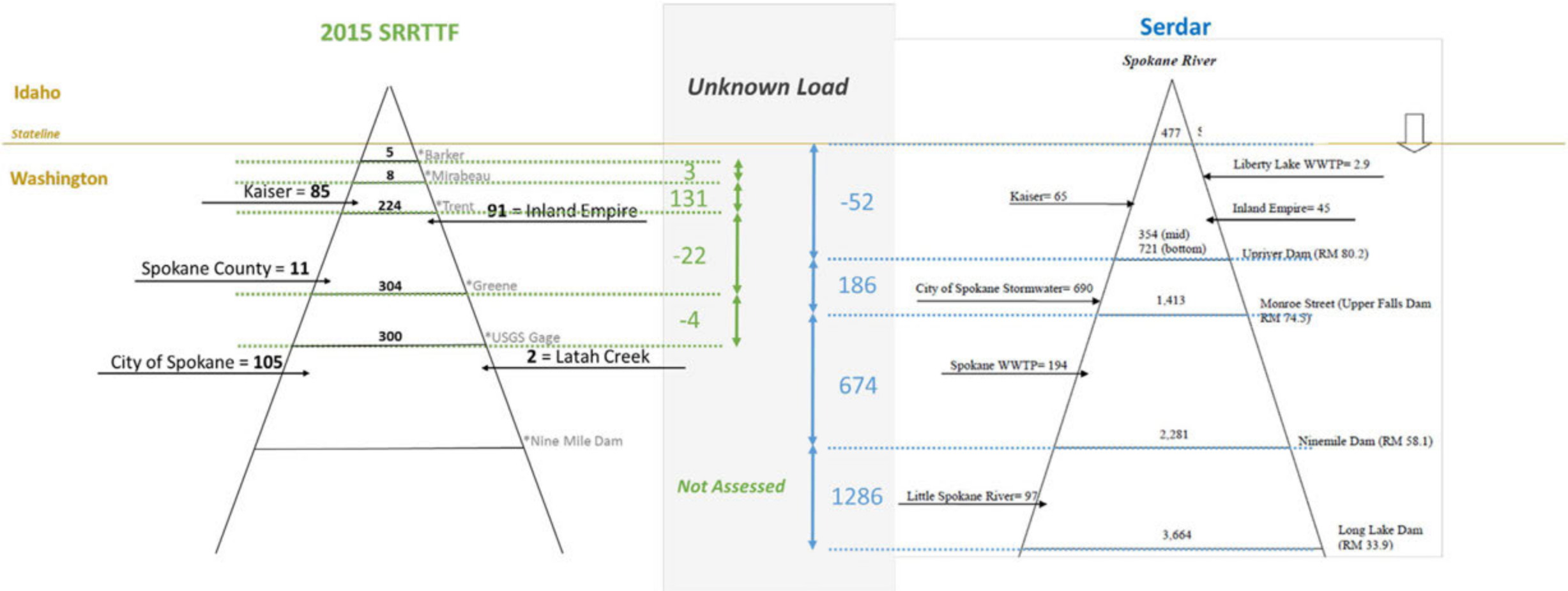
# Reconciling Serdar with Recent Studies

## Comparison to 2014 SRRTTF



# Reconciling Serdar with Recent Studies

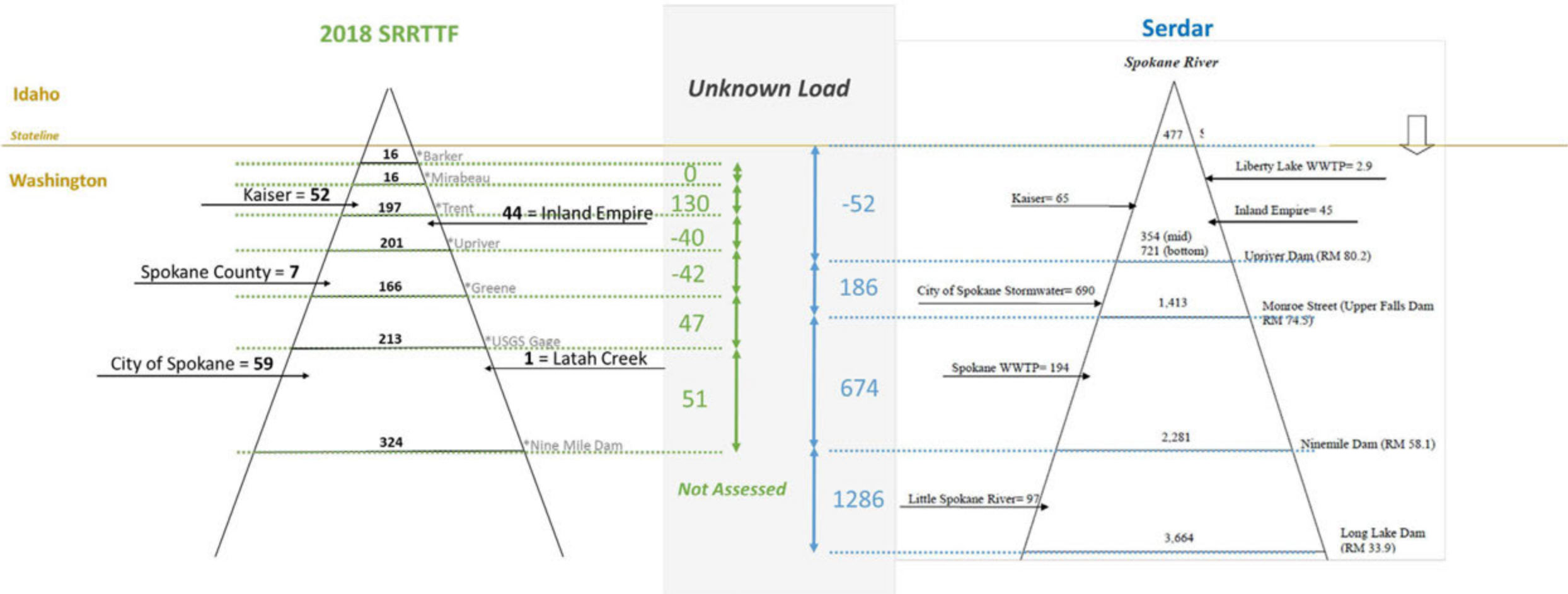
## Comparison to 2015 SRRTTF





# Reconciling Serdar with Recent Studies

## Comparison to 2018 SRRTTF



# Reconciling Serdar

- Side-by-side comparison of four primary studies

River Location	Unknown Load from 2014 Synoptic	Unknown Load from 2015 Synoptic	Unknown Load from 2018 Data	Unknown Loads from Serdar Pyramid
Lake CdA	-0.56	Not Assessed	Not Assessed	-52.4
Post Falls	-13.45			
Post Falls				
Barker	180.69	3.24	-0.44	
Barker		131.48	129.91	
Mirabeau				
Mirabeau		-5.95	-22.15	
Trent	-41.61			
Trent				
	-4.02		46.95	
Upriver				
Upriver				
Greene				
Greene	Not Assessed	Not Assessed	51.39	185.5
USGS Gage				
USGS Gage				
	674			
Nine Mile				
Long Lake Dam	Not Assessed			1286



# Reconciling Serdar

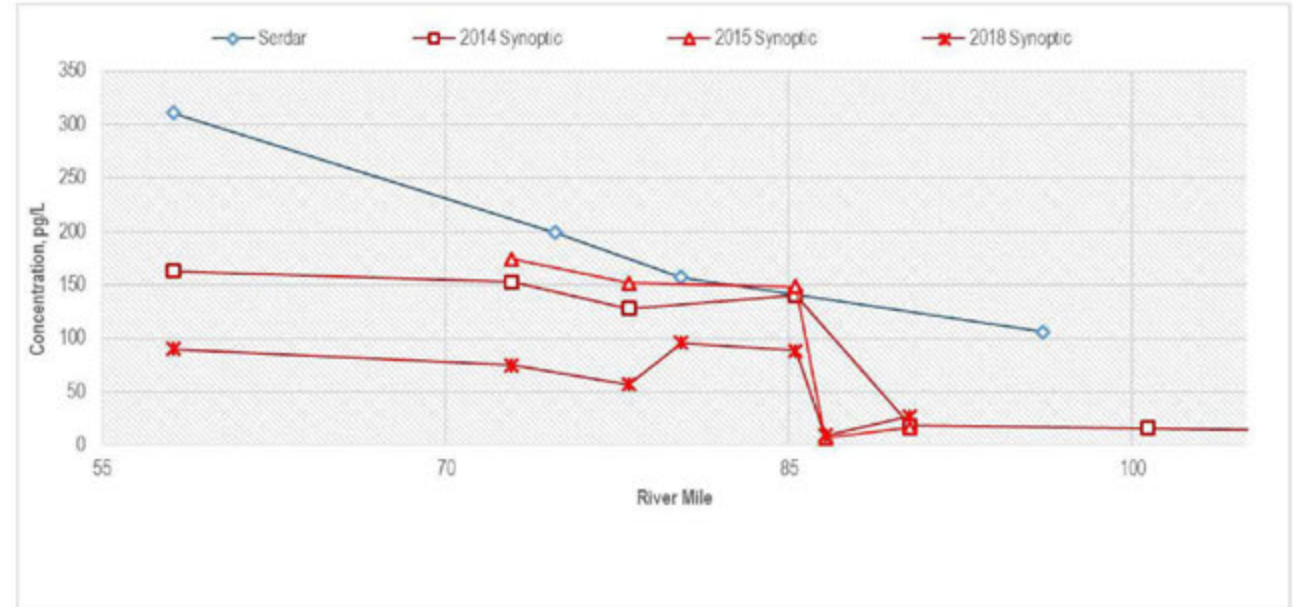
- The majority of the unknown Serdar load occurs outside of the Task Force study area
  - Apples to oranges
- Task Force studies consistently conclude a large groundwater source between Barker and Trent
- Serdar shows larger unknown load downstream of Upriver Dam

River Location	Unknown Load from 2014 Synoptic	Unknown Load from 2015 Synoptic	Unknown Load from 2018 Data	Unknown Loads from Serdar Pyramid	
Lake CdA	-0.56	Not Assessed	Not Assessed	-52.4	
Post Falls					
Post Falls					
	-13.45				
Barker					
Barker					
Mirabeau	180.69	3.24	-0.44		
Mirabeau		131.48	129.91		
Trent					
Trent	-5.95	-22.15	-40.45	185.5	
Upriver					
Upriver					
			-41.61		
Greene					
Greene		-4.02	46.95		
USGS Gage					
USGS Gage	Not Assessed	Not Assessed	51.39		674
Nine Mile					
Long Lake Dam	Not Assessed			1286	

# Reconciling Serdar with Recent Studies

## Comparing Observed Concentrations

- Serdar has higher upstream concentration
  - >100 vs. 20 pg/l
  - Explains absence of unknown load in Barker-Trent region
- Serdar has much higher concentration at Nine Mile
  - Explains larger unknown load in downstream reach



# Potential Explanations for Remaining Discrepancies

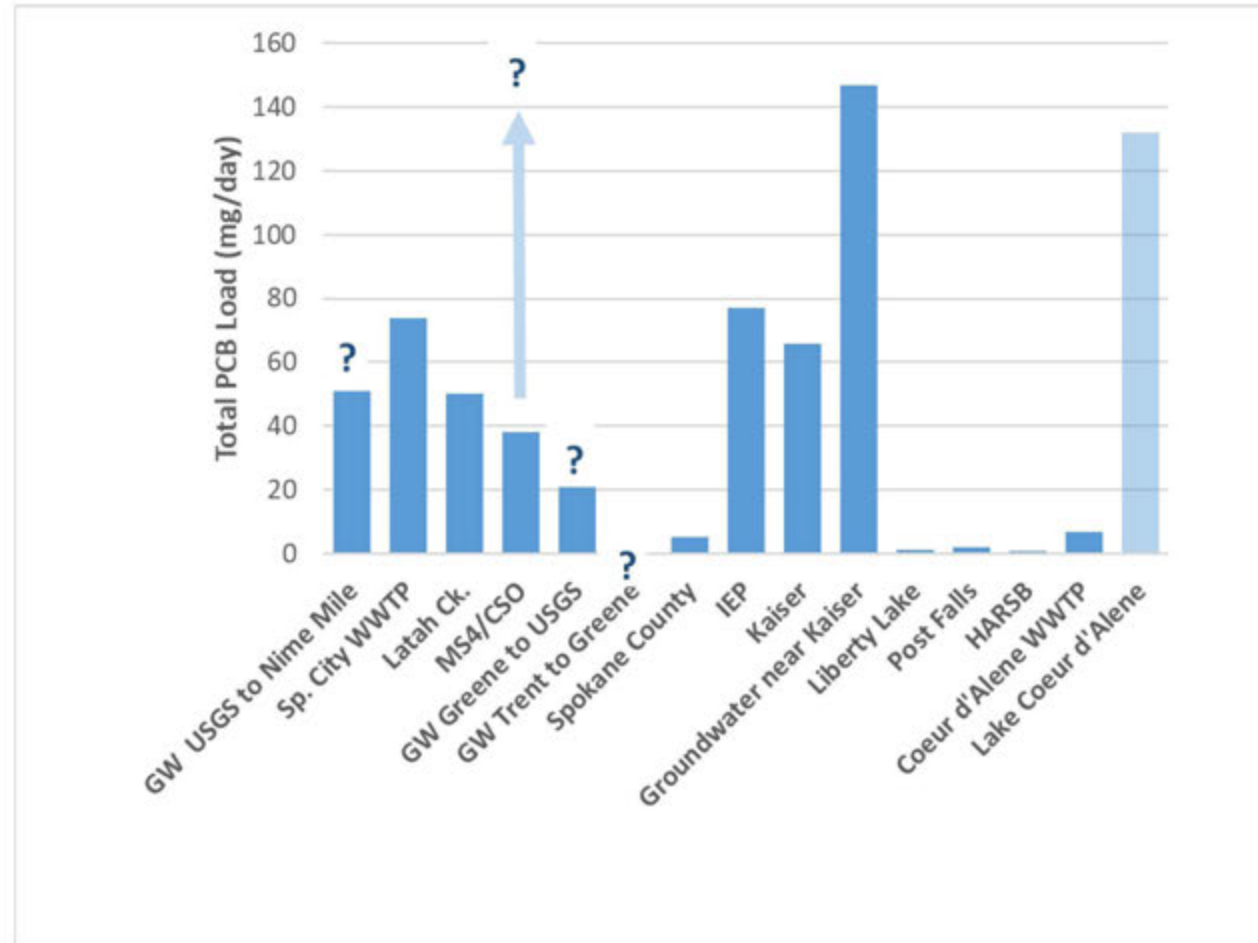
- Things have changed since 2003-2004
- Unknown loads vary seasonally
  - Serdar sampled Fall through Spring; Task Force in August
  - Task Force monthly monitoring results could be interpreted as supporting an additional unknown load
    - Consistently higher load at Nine Mile than sum of upstream sources
    - Study not designed to assess mass balance
- Monitoring methods aren't comparable

# Summary of Existing Loading Pathways

- Re-visit Comprehensive Plan assessment of wastewater loads
- Supplement with more recent Task Force work



# Summary of Existing Loading Pathways





# Summary of Existing Loading Pathways

- Key unknowns
  - Contribution of sources up-gradient of Kaiser
  - Groundwater/other interactions between Plante's Ferry and Greene St.
  - Groundwater loading between Greene St. and USGS gage
  - Groundwater loading USGS gage and Nine Mile
  - Wet weather loading

## Key Unknowns

### Contribution of Sources Up-Gradient of Kaiser

- Analysis conducted in 2018
- Samples from Kaiser Plume and River Wells are similar and dominated by a pattern that resembles Aroclor 1248
- Largest contributor to the background wells resembles Aroclor 1254, and also appears in River Wells
- Rough estimate exists of load from up-gradient wells, but confounded by spikiness of data PCB

# Key Unknowns

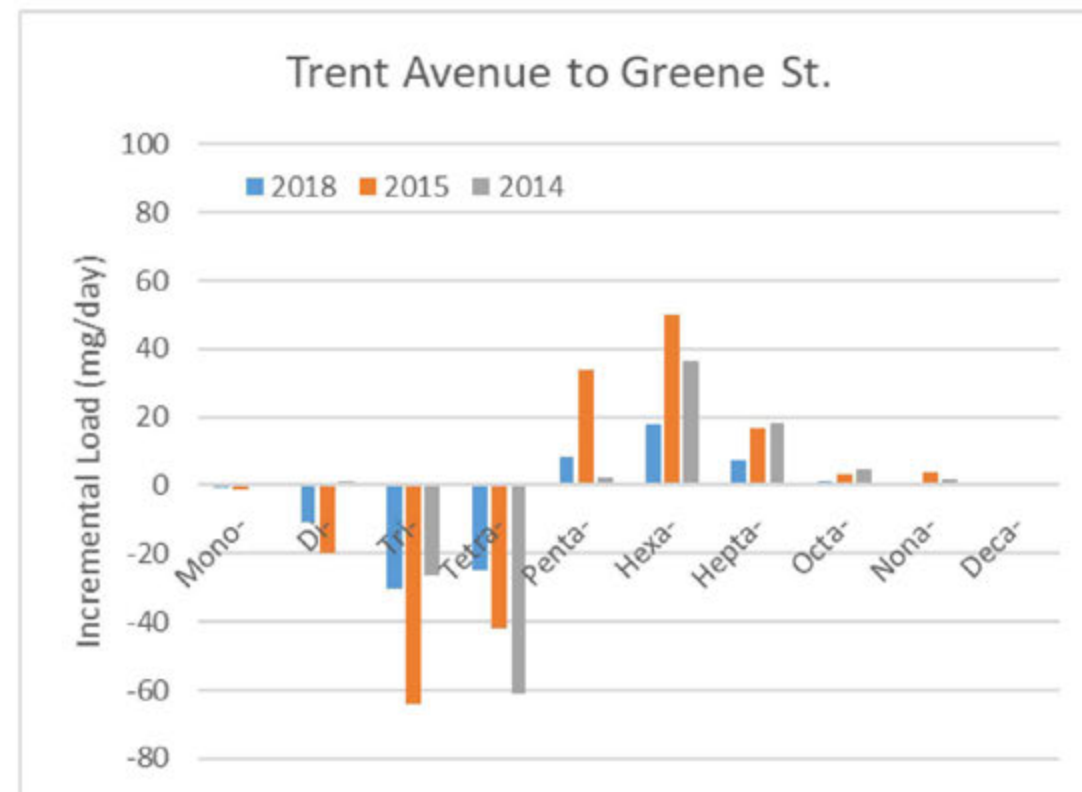
## Contribution of Sources Up-Gradient of Kaiser

- Next steps identified in 2017
  - See what results of 2018 synoptic survey showed
    - No evidence of groundwater loading at Mirabeau
  - See what results of 2018 biofilm sampling showed

# Key Unknowns

## Groundwater/Other Interactions between Plante's Ferry and Greene St.

- Mass balance shows consistent results across synoptic surveys
  - Loss of di- through tetra-homologs
  - Gain of penta- through hepta-homologs





# Key Unknowns

## Groundwater/Other Interactions between Plante's Ferry and Greene St.

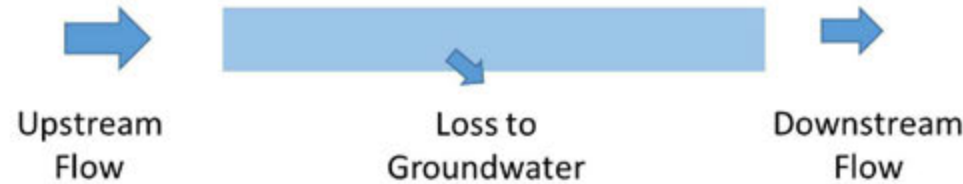
- Three theories have been proposed
  - Preferential loss of lower-chlorinated homologs
    - Transport to groundwater
    - Volatilization at Upriver Dam
  - Groundwater interaction more complicated than currently assumed



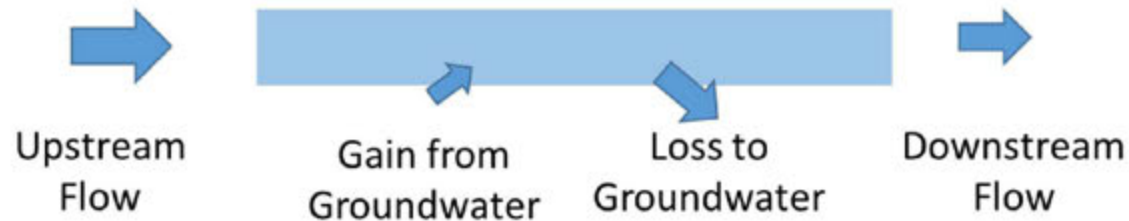
# Key Unknowns

## Groundwater/Other Interactions between Plante's Ferry and Greene St.

- Groundwater interaction more complicated than assumed
- Mass balance approach currently assumes that a losing reach is purely losing



- More complicated flow pattern could confound mass balance



# Key Unknowns

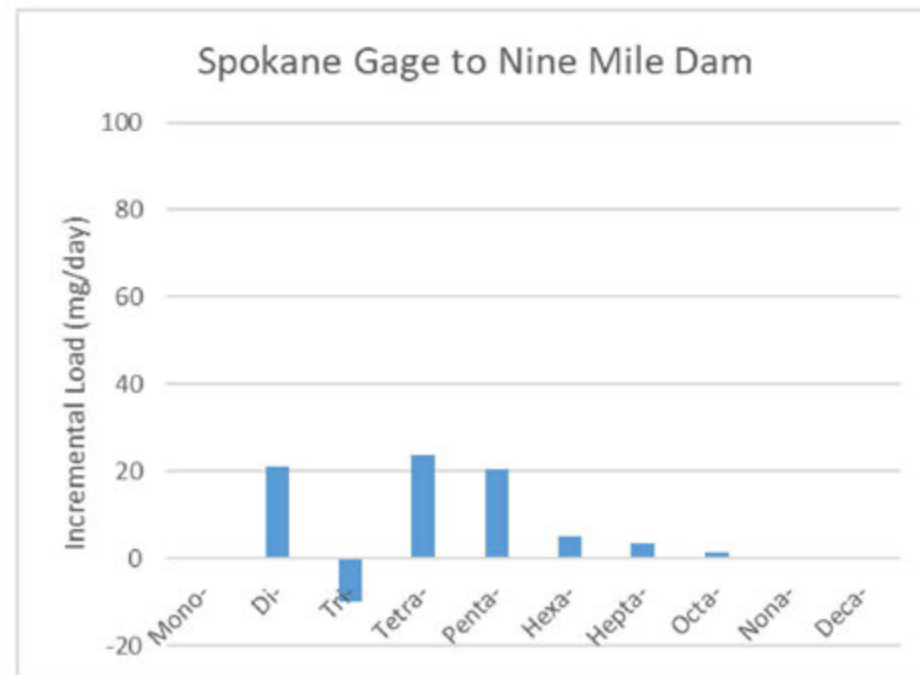
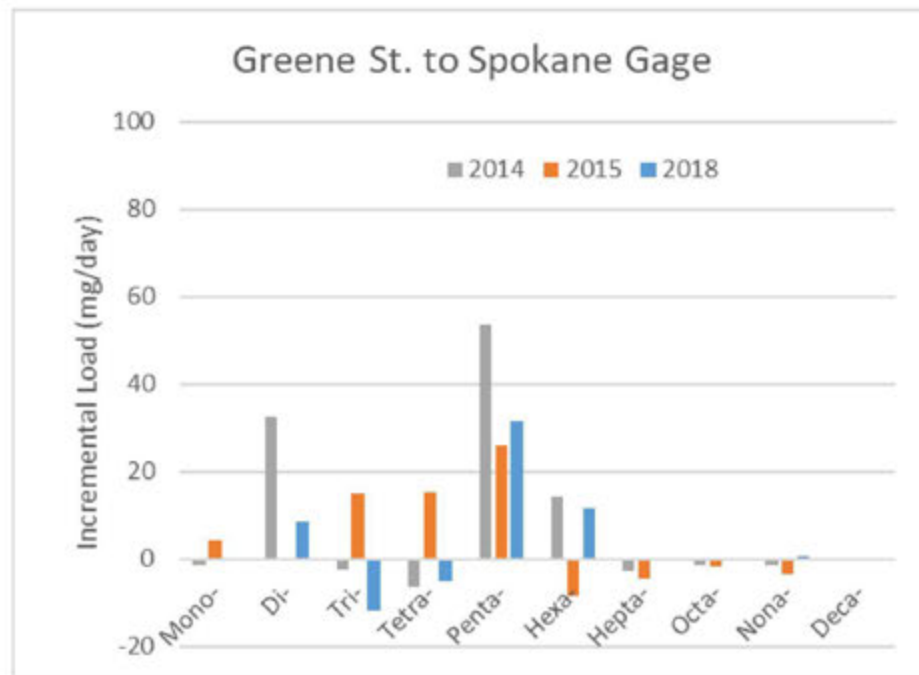
## Groundwater Loading between Greene St. and USGS Gage

- Analysis conducted in 2018
- Samples from Kaiser Plume and River Wells are similar and dominated by a pattern that resembles Aroclor 1248
- Largest contributor to the background wells resembles Aroclor 1254, and also appears in River Wells
- Rough estimate exists of load from up-gradient wells, but confounded by spikiness of data PCB

# Key Unknowns

## Groundwater Contribution Downstream of Greene St.

- Homolog-specific mass balances
- Less consistent patterns seen from Greene St. to Nine Mile
  - Gain of penta- homolog between Green and USGS Gage
  - Only one year of data for USGS Gage to Nine Mile



# Summary of Existing Loading Pathways

